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IX.—*Additional Uredineae from the Neighbourhood of Simla.*
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(With Plates IV and V.)

Since the completion of my Descriptive List of the Simla *Uredineae*, published in former volumes of the Journal of this Society I have found, or have been supplied with, 32 other species; which are described in the following pages. Of these 32 species, 4 are *Uromyces* (2 new), 11 *Puccinia* (5 new), 3 *Phragmidia* (all new), 1 *Xenodochus* (new), 2 *Melampsora* (1 new), 5 isolated Aecidial Forms (3 probably new), and 6 isolated *Uredo* Forms (5 probably new). Of the 32 species described, therefore, probably 20 are new.

HEMIUROMYCES.

UROMYCES VIGNAE, n. s.

On *Vigna vexillata*, Benth.

I found this plant (on Tara Devi) towards the end of August immensely attacked by a species of *Uromyces*. The leaves were sometimes almost blackened with pustules. These were irregularly scattered over the leaf blade on both surfaces, but more freely over the lower

surface; and it appeared to me probable that they first emerged from this surface, and later from the upper surface, at a more advanced stage. Each pustule was round and convex, and without any paling of tissue around. On a few of the younger leaves I found some paler brown uredo pustules, on both surfaces of the leaf. Except in colour they were similar to the teleutospore pustules.

The *uredospores* are brownish red, oval to round, thin walled, very spiny, and with a few immature teleutospores among them (Pl. V, fig. 19). They measured when fresh and just wetted $26-19 \times 19-18\mu$.

The *teleutospores* are deep brown, oval, very deciduous, with a portion of colourless stalk adherent, with a pale brown shallow mammilla at the free end, a clear nuclear vesicle, a germ pore just under the mammilla, and a smooth surface (Pl. V, fig. 19). The fresh spores just wetted measured $35-27 \times 22-20\mu$. The portion of adherent stalk measured up to 40μ in length. These spores refused to germinate, probably requiring a period of rest. But some uredospores germinated throwing out simple long unbranched tubes.

As this host is nearly related to *Lathyrus sativus*, I at first thought the fungus must be the same as that I have described elsewhere* on that plant, namely, *Uromyces Pisi*, Pers.; but the uredospores of the fungus on *Vigna* are considerably smaller, whilst the teleutospores are larger. It is therefore probable that the species I have here described is different, and I have named it *Uromyces Vignae*.

UROMYCES AGROPYRI, n. s.

On *Agropyrum*, sp.

This grass was collected also by Mr. Lacey at Ralli (Bashahr), 7,000 feet, in October.

On some leaves there were light brown pustules on both leaf surfaces, and these contained uredospores. Other pustules were long, linear and black on the under leaf surface, somewhat resembling pustules of *P. graminis*.

The *uredospores* are round to oval, pale brown, densely warted, with several germ pores (4 to 5), and measured when just wetted $23-20 \times 21-19\mu$.

The *teleutospores* are lightly adherent to their beds, coming off with a small piece of stalk attached. They are light yellowish brown, much thickened at the apex, smooth on the surface, with a clear nuclear vesicle, measuring when just wetted $37-28 \times 18-16\mu$.

Hitherto, so far as I am aware, this genus of grasses was known to

* Journal of Botany, Sept. 1890.

harbour only two species of *Puccinia* (*P. graminis* and *P. coronata*). This is therefore probably a new species.

UROMYCES PULVINATUS, Kalchb. et Cooke.?

On *Euphorbia hypericifolia*, Linn. var. *indica*.

Mr. Lace collected a *Puccinia* on this species of *Euphorbia* in October in a low valley of Bashahr, about 6,000 feet above the sea level. The under-surfaces of the leaves were profusely covered with dark brown circular pustules, usually distinct from one another, but sometimes coalescing. The spores are readily scraped off. These consist of:—*uredospores* which are yellow, thin-walled, spiny, and $20 \times 19\mu$; and *teleutospores*. These are small, brown, thick-walled, single-celled, with a small piece of stalk adhering (sometimes none), warted on the surface, and generally with a clear nuclear vesicle. When just wetted they measure $21-17 \times 18-16\mu$.

Of the several species of *Uromyces* which inhabit species of *Euphorbia* the one I have just described comes nearest *U. pulvinatus*, Kalchb. et Cooke, and *U. Myristica*, B. et B. The former has been described from South Africa, and the latter from North America. In size of spore the Himalayan fungus resembles the former more than the latter; but the spores of *U. pulvinatus* are smooth, whilst those of *U. Myristica* are punctated like mine.

MICRUROMYCES or LEPTUROMYCES.

UROMYCES AMBIENS, Cooke.

On *Buxus sempervirens*, Linn.

Specimens of this fungus were gathered by Mr. Lace in the Bhabar Valley, Bashahr (6,000 feet) in October. The leaves were studded with circular patches 1—4 mm. in diameter. Some of these were orange yellow, and others pale in the centre, but surrounded by a black circle. The centres of all patches contained very prominent papillae (spermatogonia?). All the pustules were hypophyllous. In the case of patches which were not black the central papillae were surrounded by a circular mound covered with epidermis. This mound was a circular covered spore pustule. The spores were orange red, but as they were thick walled and otherwise like immature teleutospores I do not regard them as uredospores. The black circles surrounding the other patches were naked teleutospore beds. The spores from such parts are large, yellowish brown, round to oval, fairly firmly adherent, coming off usually with a short stalk or none, thick walled, showing a distinct pore at the

summit which is not thickened. Their surfaces were smooth, and they measured when just wetted $44-40 \times 36-34\mu$.

This is doubtless *Uromyces ambiens*, but I have no access to the measurements of the spores. Cooke's specimens apparently came from the Himalayas.

HEMIPUCCINIA.

PUCCINIA SORGHI, Schw.

On *Zea Mays*, Linn.

I had long searched in fields of maize for a Uredine, but without success until 1890 when I found it in some fields at Mashobra. Up to this time I was acquainted with the fungus only on *Sorghum vulgare*, on specimens of the plant sent to me for examination from the Poona district. But this is absolutely the first record of its existence on maize in India, so far as I am aware. My specimens were gathered early in October. Pustules were found abundantly on both leaf surfaces, some covered entirely with a scale of epidermis, whilst others were more or less naked. The covered pustules contained uredospores, the naked ones mostly teleutospores, and the perfectly matured open ones, which are inky black, only teleutospores. Some pustules were minute and circular, others long and even linear.

The *uredospores* are pale brownish red, round to oval, beset with shallow warts or short spines, and measure when just wetted $30-26 \times 26-20\mu$. By applying sulphuric acid I detected 3 germ pores in each spore, arranged around the short equator.

The *teleutospores* are firmly attached, breaking off with a portion of stalk adhering. They are reddish brown, rounded at both ends, thickened at the free end, constricted at the septum, and apparently smooth on the surface. When just wetted they measured $42-32 \times 18-16\mu$. They refused to germinate immediately after ripening. There were no paraphyses.

This fungus is much more like *Pucc. Sorghi* than that which grows on *Sorghum vulgare*, and which I have described elsewhere.* In the first place the fungus on *Zea* has no paraphyses, and in the second the measurements of both uredo- and teleutospores approximate those given for *Pucc. Sorghi* much more closely. In the publication above alluded to I referred the parasite on *Sorghum* with hesitation to *P. Sorghi*. I am now inclined to think that the latter is a different species. Lastly, even later I found a *Puccinia* on *Pennisetum typhoideum*, Rich. (Bajra)

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at Erode in the Madras Presidency, which is undoubtedly the same as that on *Sorghum*. As neither of these fungi (on *Sorghum* and *Pennisetum*) are Himalayan I shall not describe them in detail here; but in order to enforce my argument that the fungus on *Zea* is *P. Sorghi*, whilst that on *Sorghum* and *Pennisetum* is a different species, which I shall call *Puccinia Penniseti*, I subjoin in tabular form their salient characters.

| Host. | Uredospores. | Teleutospores. | Paraphyses. | Apical thickening. | Germ pores in uredospores. |
|-------------|---------------|----------------|-------------|--------------------|----------------------------|
| Pennisetum | 34-30 × 24-22 | 48-44 × 29-26 | present. | none. | 2 |
| Sorghum ... | 34-30 × 22-20 | 50-41 × 29-22 | present. | none. | 4-5 |
| Zea ... | 30-26 × 26-20 | 42-32 × 18-16 | none. | present. | 3 |

Puccinia ELLISII, De-Toni ?

On *Angelica glauca*, Edgw.

This plant was found by Dr. G. Watt at Fagoo in August, bearing uredo- and teleutospore pustules, both minute, discrete, and hypophyllous; but whilst the former are pale yellow, the latter are dark brown to black. Both kinds of pustule occurred together on the same leaf.

The *uredospores* are round to oval, very pale yellow, very spiny, and when just wetted 30 - 24 × 25 - 20 μ . (Pl. IV, fig. 9).

The *teleutospores* are deep brown, rounded at both ends, slightly constricted at the septum, coming off with little or no stalk adhering, not thickened as a rule at the free end, and tuberculated over both cells (Pl. IV, fig. 9). They are sometimes irregular in shape. They measured when just wetted 38 - 22 × 22 μ .

This is possibly *Pucc. Ellisii*, though both the uredo- and teleutospores of this last mentioned species are larger, the former measuring 35 - 30 × 30 - 24, and the latter 40 - 35 × 25 - 20 μ . It is certainly not *Pucc. Angelicae*, Schum. which shows a tendency to erupt along the nerves, among other differing characters.

Puccinia CASTAGNEI, Thüm ?

On *Apium graveolens*, Linn.

I have hitherto confused a fungus on this host with *Pucc. Pimpinellae*, Strauss; but it is certainly distinct.

The *uredospores* are very pale brown, covered sparsely with spines, and with three germ pores, each covered with a hyaline semilunar

thickening, like that described in *Pucc. Prenanthis*. Through each of these a commencing germ tube protrudes, but one only develops fully. They are in pustules mostly hypophyllous, but some few epiphyllous. These uredospores afford another instance of extremely long retained power to germinate. I put some spores scraped off from leaves gathered on the 31st October into water on the 13th June, and found on the following day that many had germinated most freely, although the accompanying teleutospores remained ungerminated.

The *teleutospores* are brownish yellow, very irregular in shape, the septum often oblique, and even perpendicular, slightly constricted at the septum, generally not thickened at the free end, though sometimes slightly so, mostly rounded at both ends, but sometimes with the lower cell narrowing towards the stalk (Pl. V, fig. 18). After lying 24 hours in water these spores measured $41 - 26 \times 24 - 18\mu$.

This is possibly *Pucc. Castagnei*, whose teleutospores are said to be very irregular and to measure $46 - 36 \times 24 - 18\mu$.

Puccinia Eulaliae, n. s.

On *Pollinia japonica*, Haeck.

The leaves of this grass presented dark reddish brown linear pustules, mostly on their under-surfaces. These pustules contained uredo- and teleutospores with numerous capitate paraphyses.

The *uredospores* are oval or pyriform, pale brown, and spiny, and measure when just wetted $30 - 28 \times 21 - 20\mu$.

The *teleutospores* are reddish brown: the upper cell is rounded and not thickened specially anywhere; the lower is broadly wedge-shaped. The surface of the spores is smooth, and they usually have a short piece of stalk adhering. They measure when just wetted $38 - 34 \times 20 - 18\mu$. The paraphyses are numerous, reddish brown, capitate, the heads measuring about 16μ . in diameter.

This is probably a new species.

MICROPuccinia.

Puccinia excelsa, n. s.

On *Phlomis lamiifolia*, Royle.

I found this plant early in September on the summit of the Huttoo peak bearing *Puccinia* pustules. I next found it, about the same time at Mahasu, a hill close to Simla. The leaves were densely bespattered on the under surfaces with fairly large, round to oval, dark brown, almost black, circular hemispherical pustules, with a smaller less fre-

quent epiphyllous eruption opposite the beds below. The upper surface of attacked leaves is rendered conspicuous by the yellow zones surrounding the pustules. Pustules were also found on the petiole and smaller stems, though not so frequently.

The spores are fairly easily detached, coming off as a rule with no portion of stalk adhering. They are dark brown, somewhat irregular in size and shape, mostly distinctly constricted at the septum, and mostly narrowing towards the free end, where there is a slight pale mammilla or conical thickening (Pl. V, fig. 12). At the base the spore is sometimes rounded, and sometimes narrowed. It is smooth on the surface. The fresh spores examined at once in water measure $40 - 28 \times 18 - 14\mu$.

No uredospores are apparently formed by this species, since I got specimens of teleutospores from the earliest stages of development. The teleutospores would not germinate immediately after ripening.

There is no doubt, I think, that this fungus is distinct from *P. Phlomidis*, Thüm.

LEPTOPUCCINIA.

PUCCINIA USTALIS, Berk. ?

On *Ranunculus hirtellus*, Royle.

I found seedlings of this plant bearing teleutospore pustules on the Mattiana hill on the 4th September. The pustules were quite young, and there was no trace of uredospore. The teleutospore pustules were small, dark, circular, and hypophyllous, with spots of paling on the upper leaf surface. These pustules were confined to the youngest leaves, and were never found on the upper ones. The pustules had a distinct though not pronounced circinate arrangement. The spores are very firmly adherent; they are long, more or less spindle-shaped, pale yellowish brown, much thickened and conical at the free end, well constricted at the septum, and narrowing towards the stalk. The surface is smooth (Pl. V, fig. 13). In scrapings I noticed many empty spore cases, and I presume therefore that the species is a *Leptopuccinia*. When just wetted the spores measured $61 - 46 \times 23 - 8\mu$, the apical thickening being $10 - 4\mu$ in depth. I placed some spores in water on the 10th September, and on the following day found some had germinated. The sporidia are oval or somewhat semilunar, colourless, and $13 \times 6\mu$, in measurement. The sterigmata are four in number, short, conical, and pointed, and together with the whole premycelium colourless.

This is possibly *P. ustalis*, Berk.; but I have no access to the spore measurements.

MICRO or LEPTOPUCCINIA.

PUCCINIA DOLORIS, Speg. ?

On *Erigeron alpinus*, var. *multicaulis*, Wall.

This plant, harbouring a species of *Puccinia*, was gathered by Mr. Lace on the 27th August near the banks of the Sutlej in Bashahr, at an elevation of about 7,000 feet. The under surfaces of the leaves bore numerous large black pustules, irregularly scattered as a rule, but sometimes with several smaller pustules in a circlet around a larger central one. Most pustules were naked, but some were covered over with a scale of epidermis. Though most pustules are hypophyllous some few are on the upper leaf surface.

The spores are readily detached, coming off with only a very small fragment of stalk adhering. They are yellowish brown, rounded at both ends, well constricted at the septum, thickened and broadly conical at the free end, beset externally over both cells with shallow short ridges and tubercles, and measuring when just wetted $42-34 \times 18-16\mu$. The thickening at the free end is usually 6μ in depth. I placed them in water in October, but they did not germinate.

This fungus resembles *Pucc. doloris* as described by De-Toni* in many respects, and I have accordingly named it so. But as *P. doloris* is known only, so far as I am aware, from the Argentine Republic, it is quite possible that the Himalayan species is distinct.

PUCCINIA SAXIFRAGAE-MICRANTHAE, n. s.

On *Saxifraga micrantha*, Edgw.

Mr. Lace collected this plant, bearing a *Puccinia*, in Bashahr at an elevation of 9,500 feet. On the under leaf surfaces were a number of minute, circular, discrete, brown pustules, sometimes very numerous.

The teleutospores are readily detached, and many were found to be empty. The species is probably therefore a *Leptopuccinia*. They are pale brown, not thickened anywhere, with a slight apical mammilla, usually slightly constricted at the septum, but sometimes considerably so, and somewhat irregular in size and shape. When just wetted they measure $35-26 \times 14-12\mu$. I placed these spores in water, but none germinated. There were no uredospores in the specimens sent to me.

This species is quite distinct from *Pucc. Saxifragae-ciliatae* mihi. It is also evidently distinct from *P. Saxifragae*, Schlect.

* Saccardo, Sylloge Fungorum.

PUCCINIA CAUDATA, n. s.

On *Stellaria paniculata*, Edgw.

Dr. G. Watt collected this plant in Narkanda, bearing a *Puccinia*. The teleutospore beds are dark brown, well raised with a circinate tendency, and hypophyllous, with paled patches on the upper leaf surface. The spores are very adherent, more or less spindle-shaped, pale brown, well constricted at the septum, usually much thickened at the apex, with a long piece of adherent stalk (often twice, or a little more, than the whole length of the spore) and measuring $37 - 28 \times 16 - 13\mu$. (Pl. V, fig. 17.).

This is evidently not *P. Arenariae*, Schum. and I have regarded it as a new species.

PUCCINIA CRASSA, n. s.

On *Pimpinella Griffithiana*, Boiss.

This was gathered by Mr. Lace in Ziarat in Afghanistan at 8,000 feet. The teleutospore pustules are dark brown and hypophyllous. The spores are brown, almost rounded at both ends, but diminishing somewhat towards the stalk, of which a small fragment remains adherent. They are slightly constricted at the septum, and slightly thickened at the apex (Pl. V, fig. 16). When just moistened the spores measure $50 - 41 \times 24 - 22\mu$. The epispore has shallow tubercles over both cells. They would not germinate.

This fungus is quite distinct from *P. Pimpinellae*, Strauss which is one of the most common of the *Uredineae* in Simla. Neither are the spores like any of the other species inhabiting *Pimpinella* described by De-Toni* (except perhaps *P. Pimpinella*, St var. *Eryngii*, D. C.) It is I think a new species.

PUCCINIA PULVINATA Rabenh. ?

On *Echinops niveus*, Wall.

A *Puccinia* on this host was gathered for me by Dr. G. Watt in Simla. The leaves had numerous minute well raised black pustules all epiphyllous. The spores are readily detached from their beds. The plant was in full flower inclining to seed. The spores come off sometimes with a long piece of stalk attached, sometimes with a short. The spore surface is studded with shallow tubercles. They are brown, slightly constricted at the septum, mostly rounded at both ends, the free end slightly thickened. Most spores were found empty, so they

* Saccardo, *loc. cit.*

presumably germinate at once. They measure when just wetted $52 - 45 \times 24 - 22\mu$.

This is possibly *Puccinia pulvinata*, though the measurements given by De-Toni are greater than mine ($68 - 51 \times 38 - 35\mu$).

PHRAGMIDIUM.

PHRAGMIDIUM LACEIANUM, n. s.

On *Potentilla argyrophylla*, Wall.

I first received specimens of this plant harbouring a parasite from Mr. Lace, who gathered them in Bashahr. Subsequently I found specimens myself at Narkanda, and Dr. J. Murray procured specimens at Sarhan in Kulu.

The *uredo pustules* are hypophyllous, brilliantly orange red, discrete, but often so numerous as to give an appearance of coalescence. Each individual pustule is circular and minute. The *spores* are round to oval or pyriform, bright orange red, spiny, and measuring when just wetted $24 - 20 \times 18 - 16\mu$ (Pl. IV, fig. 3).

The *teleutospore pustules* are also hypophyllous, black, circular, discrete. The *spores* are deep brown, on stalks which narrow gradually away from the spore. They are mostly five-celled; but some are four and some six-celled. The surface is apparently smooth, the free end rounded and slightly thickened, with usually a minute colourless papilla. When just wetted they measure $132 - 94 \times 50 - 41\mu$. I could not detect any germ pores; and they would not germinate immediately after ripening.

The specimens sent by Mr. Lace, and those collected by myself were on the red flowered variety, whilst those collected by Dr. Murray were on the yellow flowered variety. This fact may tend to confirm the view taken in Hooker's Flora of British India that these two are varieties of the same species.

This fungus is, I think, distinct from any of the three noted in Saccardo's Sylloge as inhabiting species of *Potentilla*. It is not *Phr. Fragariastris*, D. C., which has warty teleutospores, $75 - 45\mu$ long and 3-5 celled. It is not *Phr. Potentillae*, Pers. which has smooth teleutospores, $90 \times 26\mu$, and 3-7 celled. And it is not *Phr. Tormentillae*, Fuck. which has spores often bent, $115 \times 28\mu$, 3-8 celled, and light brown.

PHRAGMIDIUM NEPALENSE, n. s.

On *Potentilla nepalensis*, Hook.

I found this host in September attacked with a *Phragmidium* at Mattiana, some miles towards the interior from Simla. The host at

that time was in flower and held both uredo- and teleutospore pustules. Both pustules were mainly hypophyllous, but a few (especially uredo pustules) were epiphyllous.

The *uredo* pustules are very brilliantly orange red and circular, but were often so closely aggregated that they ran together. The spores are round or oval, or more or less irregular in shape, and bright orange red (Pl. IV, fig. 2). They varied much in size, $28 - 22 \times 22 - 17\mu$. There were no paraphyses.

The *teleutospore* pustules are much smaller and appear like minute black dots scattered about irregularly. The spores are very dark brown, generally constricted at the septa, apparently with 2-4 pores to each cell, 2-5 celled, but usually 4 celled, with a small and inconspicuous mammilla at the free end, looking more like a slight general thickening of the epispore (Pl. IV, fig. 2). The stalk is long, thin, and inflated at some distance from the attachment to the spore, the inflation containing orange red matter. Normal 4 celled spores measured when just wetted $68 - 66 \times 26\mu$ and a 3 celled spore $54 \times 24\mu$.

Of the three species of *Phragmidium* on species of *Potentilla* described by De-Toni* only one, namely, *Phr. Fragariastris* has so few cells to each spore, and the one I have just described is, I think, not identical with it. I have therefore named it *Phragmidium nepalense*.

PHRAGMIDIUM OCTOLOCLARE, n. s.

On *Rubus rosaefolius*, Smith.

The general appearance of the teleutosporic stage of this fungus (the only one I know it in) is very like that of *Phr. Barclayi*, Dictel,† with somewhat large circular pulverulent hypophyllous pustules.

The teleutospores are dark brown 7-9 celled usually, but mostly 8-celled. The surface is distinctly and coarsely tuberculated, and at the free end there is sometimes a minute colourless papilla, but often none. The stalk is long, swells up somewhat in water, is inflated away from the spore, and this lower part of the stalk swells, more than the upper part adjoining the spore (Pl. IV, fig. 1). The stalk is not unlike that of *Phr. Barclayi*. After lying 24 hours in water the gelatinous sheath shrinks upwards towards the spore, leaving a central axis with orange red swellings at the ends. The spore is constricted at each septum to a slight degree. Each cell of the spore is more flattened from above downwards than in the last mentioned species, the vertical depth of each cell being 10μ against 14μ in *Phr. Barclayi*. The spores (taking

* Saccardo, *loc. cit.*

† I incorrectly regarded it as *Phr. Rubi*, Pers., in my Descriptive List.

those which have 7-9 cells) measure when recently wetted $130 - 94 \times 23 - 25\mu$ but exceptionally a spore of only two cells may be found, measuring $44 \times 24\mu$. I have not observed the germination of these spores; but some spores collected in autumn and put into water did not germinate, and from this I conclude that they must rest. On the other hand some of these spores showed a cell here and there empty; so apparently under special conditions they may also germinate at once.

I am inclined to regard this fungus as distinct from *Phr. Barclayi* and *Phr. quinqueloculare*, mihi. If it be identical with either, it is with *Phr. Barclayi*; but the spores of the latter are usually 6-celled with smooth surface (or with very shallow inconspicuous warts) somewhat less in length and greater in diameter. I am also unable to match it with any of the six species described by De-Toni* on species of *Rubus*. I propose naming it *Phragmidium octoloculare*.

XENODOCHUS.

XENODOCHUS CLARKIANUS, n. s.

On *Astilbe rivularis*, Ham.

This fungus was collected by Dr. Clark in the Cheog forest about the beginning of August. On one specimen there were large irregular aecidial patches, especially on the stem, accompanied by hypertrophy, just like that caused by *Phragmidium subcorticium* on *Rosa moschata*. These aecidia were exceedingly brilliantly orange red: they occurred also on leaves. The spores are very bright orange red, in rows, squarish or oblong, densely warted, thickened a little at one end (seen best in empty spores) (Pl. IV, fig. 5). They measure $31 - 26 \times 26 - 22\mu$. There were no paraphyses.

But much more numerous were orange waxy looking beds, which to the naked eye resembled *Coleosporium* beds. These in many places simply covered the under leaf surface. I noticed that in some parts these orange waxy beds were gradually changing, and at others had changed into black beds, naked, and under a field lens looking like *Puccinia* beds. The spores from the latter are scraped off with difficulty, and when examined under the microscope presented characters most like those I have read described as *Xenodochus* spores. They have characters, as far as I am able to judge, intermediate between this genus and *Phragmidium*. The spores were in rows, usually 5 to 6 in each row, pale brown, rows being sometimes transversally septate, at others irregularly in various obliquities. The rows of spores were some-

* Saccardo, *loc. cit.*

times closely amalgamated with rows on either side. Each spore of a regular row measured about $16 \times 13\mu$ (Pl. IV, fig. 4). I placed these spores in water, but they refused to germinate.

This is apparently a new species of *Xenodochnus*. It differs considerably from *X. carbonarius*, Schlecht. in which the aecidiospores are $28 - 16 \times 20 - 15\mu$ and among which there are paraphyses. Moreover, in the last named species the teleutospore rows have 10 to 20 loculi.

MELAMPSORA.

MELAMPSORA CILIATA, n. s.

On *Populus ciliata*, Wall.

This host is abundant in Simla, and many are occasionally attacked by a species of *Melampsora*. The uredo stage makes its appearance in August or September.

The uredo pustules are minute and discrete, but often very abundant; they are light yellow, and entirely hypophyllous, with scattered yellow dots on the upper leaf surface. The spores are pale orange red, mostly oval, pretty densely covered with spines, thick walled, and measure when fresh $30 - 21 \times 22 - 20\mu$ (Pl. V, fig. 15). They are borne singly on stalks, and among them are some capitate paraphyses, with heads very distinctly, and often greatly thickened at the free end (Pl. V, fig. 15).

The teleutospore beds are at first orange red, but become brown later. They are entirely hypophyllous. The spores are in compact beds and each spore measures $34 - 30 \times 9 - 8\mu$.

This fungus is, I think, different from any of the three described by De-Toni. This will be apparent when the characters are shown tabularly.

| | Uredospores. | Teleutospores. | Paraphyses. | Remarks. |
|-------------------------------|---------------|----------------|------------------|---------------|
| <i>M. Tremulae</i> , Tul. | 24-15 × 18-13 | 55-45 × 12-11 | Clavate, 9-15. | |
| <i>M. aecidioides</i> , D. C. | 24-17 × 17-15 | ? | Clavate. | |
| <i>M. populina</i> , Jacq. | 38-28 × 20-15 | 45-40 × 13 | Capitate, 20-17. | epiphyllous. |
| <i>M. ciliata</i> , mihi ... | 30-21 × 22-20 | 34-30 × 9-8 | Capitate. | hypophyllous. |

MELAMPSORA AECIDIROIDES, D. C. ?

On *Populus alba*, Lin.

Mr. Lacey sent me specimens of the leaves of this plant collected at an elevation of 8,500 feet on the 30th August. The under surfaces

were almost wholly covered with brilliant orange red pustules, minute and discrete, though from their enormous numbers they at first sight appeared to be coalescing. The upper leaf surface is profusely flecked with yellow discoloured spots. The spores are orange red, thick walled, spiny, and measure when just wetted $24 - 21 \times 18 - 16\mu$. There were no teleutospores.

It is impossible from the uredo spores alone to determine the exact position of this fungus. Possibly it is *M. aecidioides* which occurs also on *Populus alba*. The uredospore measurements coincide very closely with those I have just described, but *M. aecidioides* has paraphyses whilst the Himalayan form has not.

ISOLATED AECIDIA.

AECIDIUM CUNNINGHAMIANUM, n. s.

On *Cotoneaster bacillaris*, Wall.

I found the leaves of this plant bearing several characteristic *Roestelia* patches first on the Mahasu hill by the road side; then fairly abundantly in Narkanda; and lastly, scarcely in Mashobra. These were found at the end of August. In all these localities, especially Narkanda and Mashobra, I did not see a single *Cupressus* tree, and this inclines me to regard the fungus as distinct from *Gymnosporangium Cunninghamianum*, mihi. The leaf patches were red above, with long filiform peridia on the lower surface, about 3-5 mm. in length. From one to five such patches were found on a single leaf. On superficial examination this fungus looks different from *Gymnosporangium Cunninghamianum*, although the peridium bursts in the same way, namely, by irregular slits on the tube sides. With a field lens numerous spermogonia could be seen on the upper leaf surface.

The aecidiospores are yellowish brown, round or oval, densely beset with minute and very shallow warts, and with apparently numerous germ pores (the addition of sulphuric acid discloses eight pores). These spores measure $28 - 26 \times 28 - 24\mu$ (Pl. IV, fig. 7). The peridial cells are paler in colour than the aecidiospores, elongated, separating readily from one another laterally, very spiny (not ridgy), and measure from $60 - 58 \times 26 - 24\mu$ (Pl. IV, fig. 7). The aecidiospores would not germinate in water.

Had it not been for the absence, as far as I could see, of *Cupressus* trees in the neighbourhood of these aecidial patches, I should have been disposed on the whole to regard this fungus as *G. Cunninghamianum*; and, indeed, this identity is still quite possible, since it is by no means easy to be certain that no *Cypress* tree exists in the forests in those

regions. In support of the view of identity are the manner of dehiscence of the peridium, and the closely corresponding sizes of the aecidiospores and the peridial cells (the former in the case of *G. Cunninghamianum* being on an average $28.6 \times 24.6\mu$, and the latter $70 \times 22\mu$). I should note also that the peridial tubes of the aecidium on *Cotoneaster* are somewhat longer than those on *Pyrus* (in the latter they are 1 to 2 mm.)

The only *Aecidium* known on *Cotoneaster* is *Aec. Mespili*, D. C.; but the aecidiospores of this species are $24 - 19\mu$ in diameter, and I do not think the Simla species can be the same. Until more is known of its life history I propose naming it *Aec. Cunninghamianum*, believing that it will probably prove to be identical with *Gymnosporangium Cunninghamianum*, mihi.

AECIDIUM MORI, n. s.

On *Ficus palmata*, Forsk.

I found this plant first attacked in a valley to the north of Mashobra, and subsequently in Simla itself during October. The leaves are often densely covered with an orange red eruption. In some cases the whole of the lower leaf surface was a mass of these bright pustules. But although the eruption is mainly hypophyllous it is also largely epiphyllous. With a field lens it is difficult to determine the nature of the fungus. Each spore heap is very minute, but shreds of white tissue are seen about them. Under the microscope however, all doubt ceases, for there are very characteristic peridial cells, and the fungus is consequently an *Aecidium*. But it is a very remarkable one in having so small and inconspicuous a peridium. To the naked eye the fungus resembles a *Uredo* form. The spore beds are scattered irregularly all over the leaf surface; but sometimes on somewhat swollen weals on the petiole and midrib. The aecidiospores are very brilliant orange red bodies, round to oval, and apparently smooth on the surface. When just wetted they measure $17 - 14 \times 16 - 14\mu$. The peridial cells are colourless and more delicate than usual. They are mostly six-sided and spiny or tuberculated. They measure $22 \times 18 - 19\mu$. I placed some of the aecidiospores in water on the 17th of October, and a few were found to have germinated on the following day. The germ tube is long, simple, and unbranched.

Saccardo mentions a *Puccinia sepulta*, B. et C. on the leaves of a species of *Ficus* from Nicaragua and two *Uredo* forms (*U. Fici*, Cast. and *U. ficicola*, Speg.); but even supposing these *Uredo* forms are really *Aecidia*, the spores of the former are much too large, and those of the latter considerably larger than the Simla fungus to permit of their being considered identical. The Simla species is probably therefore new.

This fungus is identical with that I have described as *Caeoma Mori*; and as I have subsequently found that the peridium is distinctly present though incoherent, I feel disposed to relinquish the name *Caeoma Mori* and to substitute *Aecidium Mori*.

AECIDIUM FLAVESCENS, n. s.

On *Senecio rufinervis*, D. C.

I found this plant in August bearing an *Aecidium* in the Mashobra woods. The aecidial patches are indicated conspicuously by brown patches with yellow irregular halos around them on the upper leaf surface. On the under surface the peridia are indistinctly seen against the white tomentous natural leaf surface, as they are pale in colour. The peridia are densely aggregated together, and always on the under leaf surface. The tubes are short and open stellately. I counted from one to thirty-two aecidial patches on single leaves. The patches varied from a half to 2 c.m. in diameter. The aecidiospores are oval or round, pale orange red, measuring when well moistened $22 - 20 \times 16 - 14\mu$. The peridial cells are almost isodiametric, very rugose on the surface, with short ridges and spines, and measuring $28 - 22 \times 22 - 20\mu$. (Pl. IV, fig. 8).

Later in the season leaves in the same locality bore uredospores, and still later teleutospores in the form of *Coleosporium*. I have unfortunately had no opportunity of examining these forms.

Two species of *Aecidia* on species of *Senecio* are noted by Saccardo, *Aec. Huallatinum*, Speg., and *Aec. sclerothecium*, Speg.; but the spores of the Simla species are much smaller than those of either of these two species.

AECIDIUM AQUILEGIE, Pers. ?

On *Aquilegia vulgaris*, Linn.

Mr. Lace collected this plant on the 9th August, 1890 at an elevation of 10,000 feet bearing an *Aecidium*. The peridia are hypophyllous, forming a patch of yellow below with a paled area above on which spermogonia may be seen with a field lens. The peridia open by a clean regular margin. The peridial cells are angular, almost isodiametric, five to six-sided, spiny and ridgy, and about $26 \times 20\mu$. The aecidiospores are round or faceted when just scraped off, tuberculated, and $24 - 18 \times 18 - 12\mu$.

This fungus is very possibly *Aec. Aquilegiae*, Pers. though the spores in the latter are said to be larger ($30 - 16 \times 20 - 14\mu$.) and perhaps more spiny.

AECIDIUM ORBICULARE, n. s.

On *Clematis grata*, Wall.,, *orientalis*, Linn.,, *puberula*, H. f. and T.

This *Aecidium* was sent to me first by Mr. Lace and Dr. Watt, and subsequently I found it myself at Mattiain on *Clematis grata*.

Aecidial patches were very numerous on stems, petioles, and leaves, causing considerable hypertrophy of stems and petioles, especially on *Clematis grata*. On leaves the peridia were markedly circinate in arrangement, and all were hypophyllous. The peridial tubes were long and cylindrical, and opened at the summit with an almost clean margin, *i. e.*, very minutely serrated. They measured about 0.75 m.m. in length. The spores are bright orange red, densely beset with shallow warts, round to oval or angular, 25 - 20 × 20 - 14 (*Clematis grata*) 21 - 16 × 16 - 15 (*C. orientalis*) 22 - 19 × 19 - 15 μ . (*C. puberula*).

The peridial cells were in all cases about 26 - 20 μ . in diameter, four to six-sided, with bright orange red matter in their centres, and spiny, (Pl. IV, fig. 6).

This may possibly be the New Zealand *Aec. otagensis*, Linds.; but the only description available to me is the very brief one by De-Toni, from which it is impossible to decide, since no spore measurements are given. The only other *Aecidium* described by De-Toni on *Clematis* is *Aec. Clematidis*; but the description of the peridium is unlike that I have described. The Himalayan species is therefore, I think, distinct. It is possible that this *Aecidium* is related to *Puccinia Wattiana*, mihi which occurs plentifully on *Clematis Gauriana* and *C. grata*; but in the absence of experimental proof it is impossible to determine.

ISOLATED UREDO FORMS.

UREDO COLEBROOKIAE, n. s.

On *Colebrookia oppositifolia*, Smith.

This fungus was collected by Dr. Watt near Suni in October. The under surfaces of the leaves were almost uniformly orange red in colour from innumerable orange red pustules. These pustules are really distinct, but appear to be coalescing from their great numbers, and from the hairy nature of the leaf surface, in which the spores get entangled. Dr. Watt informed me that showers of red dust fell from the leaves as he picked them. The spores are pale orange red, oval, very spiny, measuring when just wetted 28 - 20 × 20 - 17 μ . These spores were put into water some few days after collection, but they did not germinate freely; one or two did so, however, throwing out long simple sinuous tubes.

UREDIO ICHNOCARPI, n. s.

On *Ichnocarpus frutescens*, Br.

This fungus was also collected by Dr. Watt in the same neighbourhood, and at the same time. The leaves bore a few scattered isolated, bright orange red pustules on the under leaf surface. The spores were readily scraped off. They are bright orange red, oval, studded with large coarse warts or spines, and measure when just wetted $24 - 20 \times 16 - 21\mu$. Even in empty spores I could not detect any germ pores. Among the scraped off uredospores I saw some immature single celled stalked spores which I imagine are teleutospores (*Uromyces*); but they were too immature to allow of decision. They were colourless at this early stage.

An *Aecidium Apocyni*, Schwein. is known to occur in Carolina, Kansas, and Illinois; but it is impossible as yet to say whether it is in any way related to the Himalayan fungus: probably it is not.

UREDIO IPOMAEAE, n. s.

On *Ipomaea hederacea*, Jacq.

This plant was collected by Dr. Watt near Sairi in September with numerous, white, irregularly shaped covered pustules on the under leaf surface. On examining the pustules they were found to contain an abundance of white powdery spores. The spores are colourless, round or squarish, apparently quite smooth on the surface, and measuring when just wetted $20 - 17 \times 16 - 14\mu$. Although I have placed this fungus here among Uredo forms I should note that it looks much like the *Aecidium* of a *Phragmidium*, differing only in not being coloured.

UREDIO PILEAE, n. s.

On *Pilea trinervia*, Wt.

I found a few of these plants in the woods at Mashobra early in October, attacked by a Uredo. The pustules were minute, pale yellow, and scattered on the under leaf surface. The spores are oval, very pale yellow, studded with prominent spines, and measured when just wetted $25 - 20 \times 20 - 14\mu$. I could find no trace of any teleutospore form up to the middle of October.

UREDIO EHRETIAE, n. s.

On *Ehretia serrata*, Roxb.

This fungus was collected by Mr. J. S. Gamble on the banks of the Tons river near Chakrata. The leaves are attacked by a Uredinous

fungus of somewhat uncertain nature. Some leaves had circular spots varying in diameter from 1 to 8 m.m., whilst others had large hypertrophies of the petiole as it enters the lamina, and these were uniformly covered with bright orange red pulverulent spores. Transverse sections through the fungus and leaf show that the spores are not borne separately on stalks, but from a cup-like depression like the pit of an aecidium without any peridium. There were also numerous superficial spermogonia. The spores are orange red, oval or pear-shaped, very spiny, decidedly thickened at the free end (remining one of the aecidio- and uredospores of *Puccinia Prainiana*). When just wetted they measure $38 - 30 \times 22 - 20\mu$. They become detached without any portion of the stalk adhering. The spores are given off from both surfaces of the leaves. By applying nitric acid I saw that each spore had two germ pores.

This is the first member of the *Boragineae* which I have seen attacked in India by a Uredine. As *Puccinia Rubigo-vera*, or some variety or allied species, is undoubtedly the most prevalent and destructive rust on wheat, barley, and oats in India, I had long looked for some associated form on a Boragineous host, and this not only by personal search, but also by correspondence. I am afraid, however, that this particular Uredine cannot be the associated form I have been looking for, although it is just possible that it is. For although the spores are given off like uredospores, the cup-shaped depressions in which they are formed, the presence of spermogonia, and the hypertrophy of the host's tissue all render it possible that we have here an anomalous *Aecidium*. This question will have to be tested by experiment.

UREDO AGRIMONIAE, D. C.

On *Agrimonia Eupatorium*, Linn.

This plant is frequently found attacked with a Uredo in these regions; but I have never seen a teleutosporic stage. The Uredo pustules are hypophyllous, very numerous, and minute. The spores are orange yellow, oval, warty or spiny, and measure $22 - 17 \times 14 - 13\mu$, when just wetted.

This is no doubt the widely distributed *Uredo Agrimoniae*.

EXPLANATION OF PLATES.

Plate IV.

1. Teleutospore of *Phr. octolocularis*, $\times 220$.
2. Teleutospore and uredospore of *Phr. nepalense*, former $\times 220$, and latter $\times 350$.

3. Teleuto- and uredospores of *Phr. Laceianum*, $\times 220$ and $\times 350$.
4. Teleutospore of *Xenodochus Clarkianum*, $\times 350$.
5. Aecidiospore of the same $\times 350$.
6. Peridial cells of *Aecidium orbiculare*, $\times 350$.
7. Peridial cells and aecidiospores of *Aec. Cunninghamianum*, *a* $\times 350$,
b $\times 220$.
8. Peridial cells of *Aec. flavescens*, $\times 350$
9. Teleuto- and uredospores of *Pucc. Ellisii*, $\times 350$.
- *10. Teleutospore of *Pucc. Wattiana*, $\times 350$.

Plate V.

11. Teleuto- and aecidiospores and promycelium of *Phr. quinqueloculare*,
 $\times 350$.
12. Teleutospores of *Pucc. excelsa*, $\times 350$.
13. Teleutospores of *Pucc. occulta*, $\times 350$.
- *14. Teleutospores of *Pucc. McIntirianus*, $\times 350$.
15. Uredospores and paraphyses of *Melampsora ciliata*, $\times 350$.
16. Teleutospores of *Pucc. crassa*, $\times 350$.
17. Teleutospores of *Pucc. caudata*, $\times 350$.
18. Teleutospores of *Pucc. Castagnei*, $\times 350$.
19. Teleuto- and uredospores of *Uromyces Vignae*, $\times 350$.

X.—Notes on the Collection of Snakes in the Indian Museum with descriptions of several new species.—By W. L. SCLATER, M. A., Deputy Superintendent of the Indian Museum.

[Received 1st August, 1891; read 5th August, 1891.]

(With Plate VI.)

The following notes were drawn up while critically examining and rearranging the collection of Snakes in the Indian Museum; the collection is a fairly large one though there are many Indian species still unrepresented, and I should be very glad if any one would assist me to fill up the gaps especially in the Southern Indian and Ceylonese forms in which the Museum is specially deficient.

The number of Snakes described by Mr. Boulenger in his work on the Reptiles of the Indian Empire and Ceylon amounts in all to 264, of this number the Indian Museum possesses examples of 196, so that no less than 68 are still wanting to complete the Indian Museum Collection; of the 68 deficiencies, however, 22 at least of the species have only been got once and are represented in the British Museum or elsewhere usually by a single specimen.

* For descriptions of these, see J. A. S. B., Vol. LIX, Pt. II, No. 2, 1890.